

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 18 OCT 2005

WIPO

PCT

Applicant's or agent's file reference 11321-P074WO		<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/US2004/024338		International filing date (day/month/year) 28.07.2004	Priority date (day/month/year) 28.07.2003	
International Patent Classification (IPC) or national classification and IPC C01B31/02, C09C1/44, C09C3/12, C08K7/24, C08K3/04, C08K9/06, C08K7/02, C08K7/14				
Applicant WILLIAM MARSH RICE UNIVERSITY et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input checked="" type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  24.02.2005		Date of completion of this report  17.10.2005		
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Marucci, A  Telephone No. +49 89 2399-		



**BEST AVAILABLE COPY**

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/US2004/024338

## Box No. 1 Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

### Description, Pages

1-29 as originally filed

### Claims, Numbers

1-67 as originally filed

### Drawings, Sheets

1/25-25/25 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/024338

---

**Box No. IV Lack of unity of invention**

---

1. ☒ In response to the invitation to restrict or pay additional fees, the applicant has:
- ☐ restricted the claims.
  - ☐ paid additional fees.
  - ☐ paid additional fees under protest.
  - ☒ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
  - ☒ not complied with for the following reasons:  
**see separate sheet**
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☐ all parts.
  - ☒ the parts relating to claims Nos. 1-40 .

---

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

---

1. Statement

Novelty (N)	Yes: Claims	2-7,10-15,18,22,27,37
	No: Claims	1,8,9,16,17,19-21,23-26,28-36,38-40
Inventive step (IS)	Yes: Claims	
	No: Claims	1-40
Industrial applicability (IA)	Yes: Claims	1-40
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**Re Item IV.**

**1.1 The separate inventions/groups of inventions are:**

**Claims 1-40:**

Silane-functionalized carbon nanotubes and method for making the same.

Composite comprising silane-functionalized carbon nanotubes and a polymer.

**Claims 41-67:**

A composite material comprising carbon nanotubes, fiber reinforcing material and a polymer. Method for preparing the same.

**1.2 They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:**

The features linking together the first and the second groups of invention are a composite material comprising carbon nanotubes and a polymer matrix. They are not novel as already anticipated by the prior art, identified as document XP2252197 (section 6.1 "Processing and characterization of nanotube-based polymer composites").

**1.3 Also, examining the possible correspondence by technical effect, one finds that the technical effect of the first group of inventions is the interaction of the silane group attached to the carbon nanotubes with the polymer matrix which increases the dispersion of the nanotubes in a polymer matrix (paragraph [0005] of the description) and that the technical effect of the second invention is the interaction between the fiber reinforcement material and carbon nanotubes in fiber-reinforced polymeric composites (paragraph [0069] of the description) which gives raise to a coating of the fiber.**

**1.4 This appears to show lack of corresponding technical effect as well. Consequently, neither the objective problem underlying the subjects of the claimed inventions, nor their solutions defined by the special technical features allow for a relationship to be established between the said inventions, which involves a single general inventive concept.**

- 1.5 In conclusion, the groups of claims are not linked by common or corresponding special technical features and define two different inventions not linked by a single general inventive concept. The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

**Re Item V.**

- 2 The following documents are referred to in this communication:

D1 : WO 01/58909 A (GOVERNMENT OF THE US ADMINISTRATION) 16 August 2001 (2001-08-16)

D2 : VELASCO-SANTOS C ET AL: "Chemical functionalization of carbon nanotubes through an organosilane" NANOTECHNOLOGY IOP PUBLISHING UK, vol. 13, no. 4, 3 July 2002 (2002-07-03), pages 495-498, XP002314113 ISSN: 0957-4484

D3 : US 6 203 814 B1 (OGATA NAOYA ET AL) 20 March 2001 (2001-03-20)

D4 : AIZAWA M ET AL: "Silylation of multi-walled carbon nanotubes" CHEMICAL PHYSICS LETTERS ELSEVIER NETHERLANDS, vol. 368, no. 1-2, 14 January 2003 (2003-01-14), pages 121-124, XP002314114 ISSN: 0009-2614

● **with regard to novelty:**

- 3.1 Document D1 discloses (the references in parentheses applying to this document): phenylethynyl-containing imide silanes which are used as a functionalizing agent for nanotubes having hydroxyl groups (page 23: "Application as a functionalising agent with clays and nanotubes"). The silane group improves the dispersion of the nanotubes in a resin by covalently reacting with the resin itself.
- 3.2 Document D2 discloses (the references in parentheses applying to this document): the silanization of carbon nanotubes through the formation of a trisilanol which reacts with the hydroxyl groups on the nanotube surface (page 495, second column). This derivatization leads to an improvement of the interaction between the nanotubes and polymer materials.
- 3.3 Document D3 discloses (the references in parentheses applying to this document):

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

**PCT/US2004/024338**

the functionalization of carbon nanotubes (column 1, lines 5-6) with silane groups (column 4, line 34; examples 16 and 17). The incorporation in a polymer matrix is foreseen (column 7, lines 1-3).

- 3.4 Document D4 discloses (the references in parentheses applying to this document):  
A method for silylating carbon nanotubes. The carbon nanotubes are previously oxidized in order to introduce polar groups on the surface (Experimental).
- 2.5 In the light of the prior art cited above, the subject-matter of claims 1, 23 and 29 is not new in the sense of Article 33(2) PCT and, therefore, the present application does not meet the criteria of Article 33(1) PCT.
- 3 **DEPENDENT CLAIMS 2-22, 24-28, 30-40**  
Dependent claims 2-22, 24-28, 30-40 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step (Article 33(2) and (3) PCT).